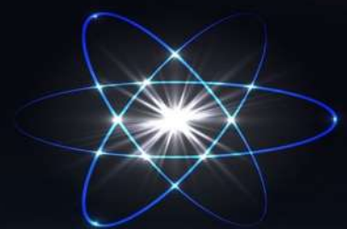
NCSP Nuclear Data Program

WANDA-2025 Workshop



Presented by:

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NCSP Execution Manager

Section Head, Nuclear Data, Criticality Safety, and Radiation Transport

Oak Ridge National Laboratory

Background / History–Mission Vision–Organization

Early history

- Defense Nuclear Facilities Safety Board (DNFSB) Recommendations:
  - 93-2 (3/23/1993): Need for a general-purpose critical experiment capability that will ensure safety in handling and storage of fissionable material.
  - 97-2 (5/19/1997): Need for improved criticality safety practices and programs to alleviate potential adverse impacts on safety and productivity of DOE operations.
- DOE Implementation Plan for 93-2 and 97-2 recommendations resulted in establishment of the US NCSP

Defense Nuclear Facilities Safety Board

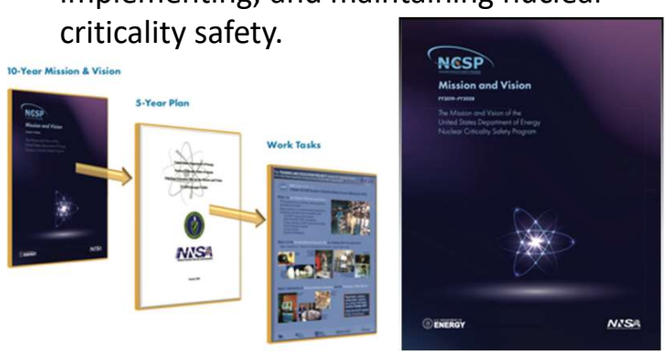
NCSP 5-year plan

Mission

Provide sustainable expert leadership, direction and the technical infrastructure necessary to develop, maintain, and disseminate the essential technical tools, training, and data required to support safe, efficient fissionable material operations within DOE.

Vision

Continually improving, adaptable, and transparent program that communicates and collaborates globally to incorporate technology, practices, and programs to be responsive to the essential technical needs of those responsible for developing, implementing, and maintaining nuclear criticality safety.



NCSP organization

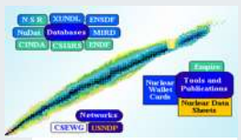
TS – Technical Support
MT – Management team
TMs – Task managers
CSSG – Criticality Safety Support Group
CSCT – Criticality Safety Coordinating Team
NDAG – Nuclear Data Advisory Group

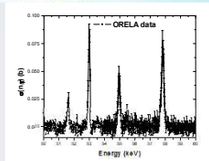
OAK RIDGE National Laboratory

Technical Program Element Activities

SCALE
AMPX
MCNP6
NJOY

NNDC





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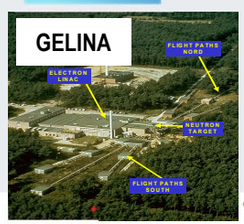


linac The Gaerttner LINAC Center

AM

ND

IPD

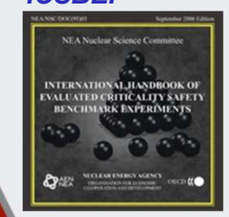
NCSP Goals

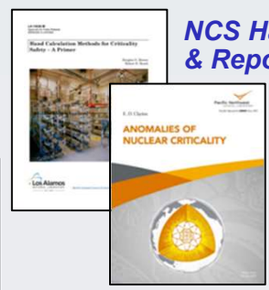
TE

IE

TS

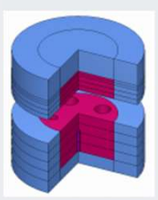
ICSBEP

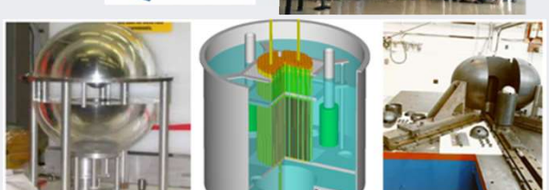


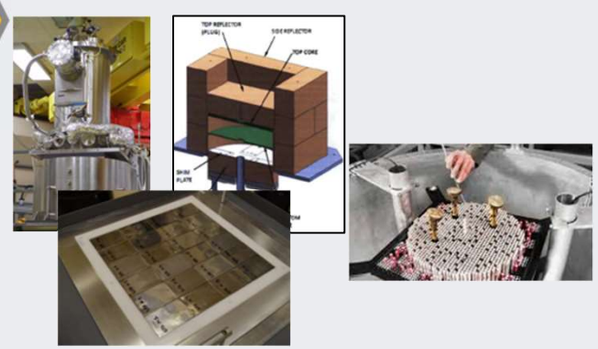


NCS Handbooks & Reports

NCSP Website
https://ncsp.llnl.gov







Succession Planning

G2

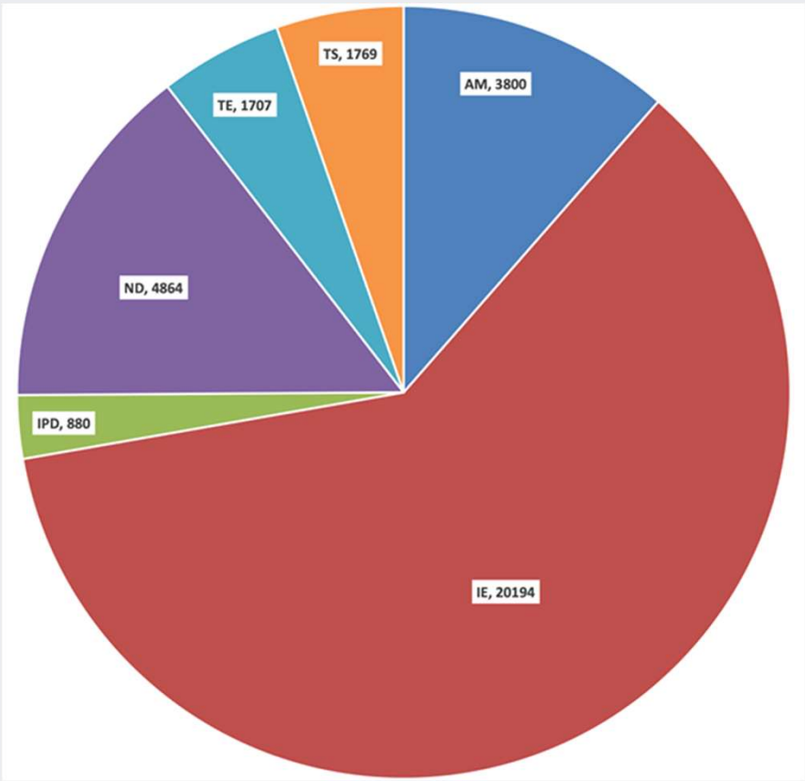
NDA Program

Program Execution

NCSP Nuclear Data Tasks and Budget (2025)

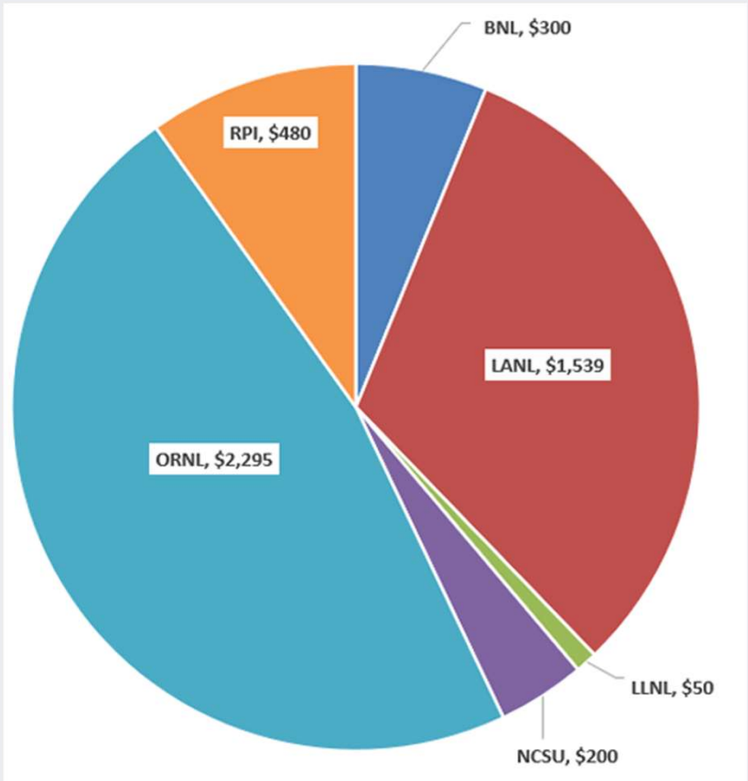
FY25 Budget $31,100k

NCSP Funding Distribution by Technical Program Element



FY2025 Nuclear Data Funding: $4,864K (16%)

NCSP Nuclear Data Funding Distribution by NCSP Site



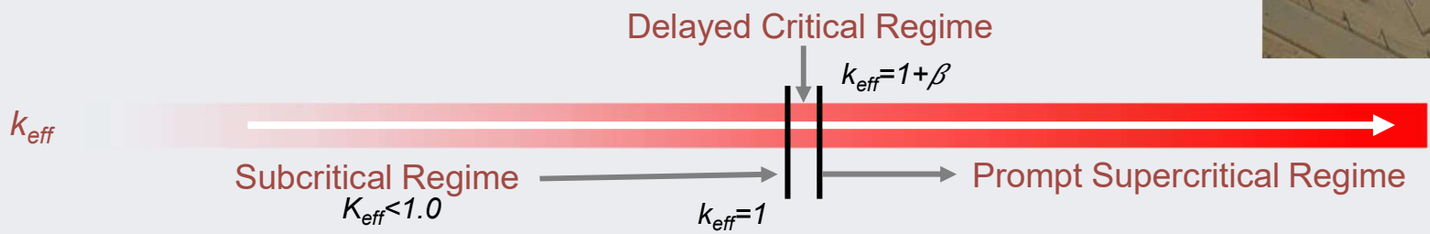
NCSP Integral Experiments

- NCSP integral measurements are performed at
  - Sandia National Laboratories (SNL) and
  - National Criticality Experiments Research Center (NCERC), currently operated by Los Alamos National Laboratory
    - NCERC is located at the Nevada National Security Site (NNSS) inside the Device Assembly Facility (DAF)
- Types of experiments that can be performed
  - Subcritical
    - Rocky Flats shells, BeRP ball, Np-237 sphere, TACS shells, etc.
  - Critical/Delayed Supercritical
    - NCERC: Planet, Comet, Godiva IV, Flattop
    - Sandia: Sandia Pulse Reactor critical assembly (2 fuel types, currently)
  - Prompt Supercritical
    - NCERC: Godiva IV (< 300 deg. C pulse)

DAF/NCERC

SNL/TA-V/SPR Facility

FY2025 Integral Experiment Funding: $20,194K (65%)



NCSP Differential Experiments

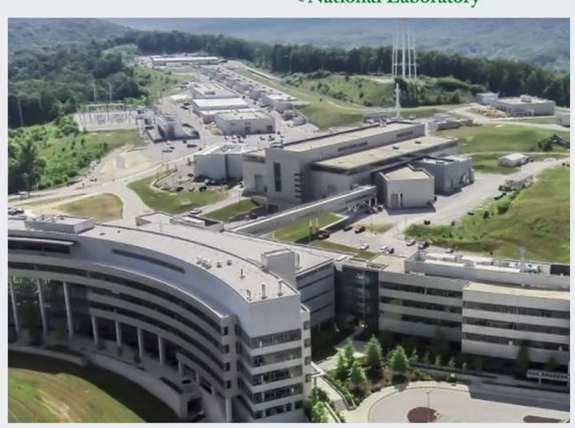
- NCSP differential nuclear data measurements are performed at
  - JRC-Geel GELINA Facility (Geel, Belgium)
    - GELINA is available via collaboration between DOE/NNSA NA-20 and Euratom (JRC-Geel)
  - ORNL Spallation Neutron Source (SNS) (Oak Ridge, TN)
  - Rensselaer Polytechnic Institute Linear Accelerator (RPI LINAC) (Troy, NY)
  - LANL (Los Alamos, NM) LANSCE/Lujan Neutron Scattering Center (LANSCE)

JRC-Geel (GELINA)

RPI LINAC

LANL LANSCE

ORNL SNS



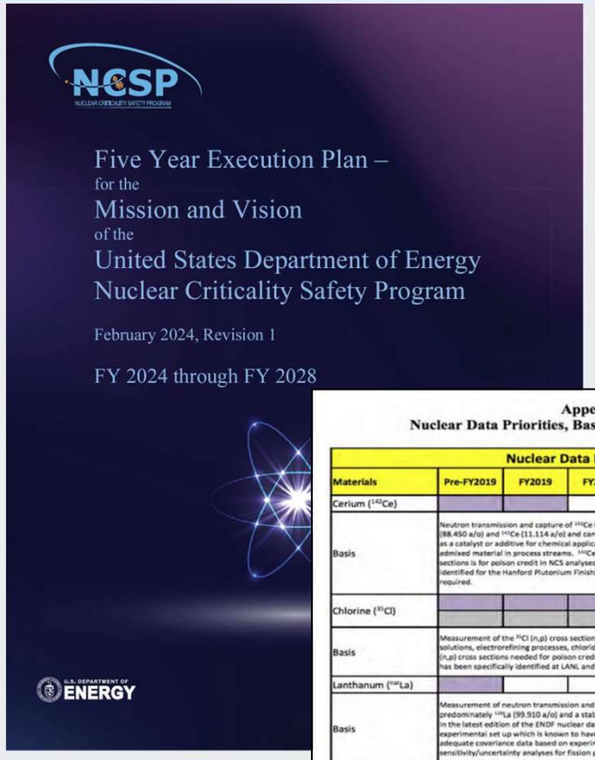
Photos referenced from:

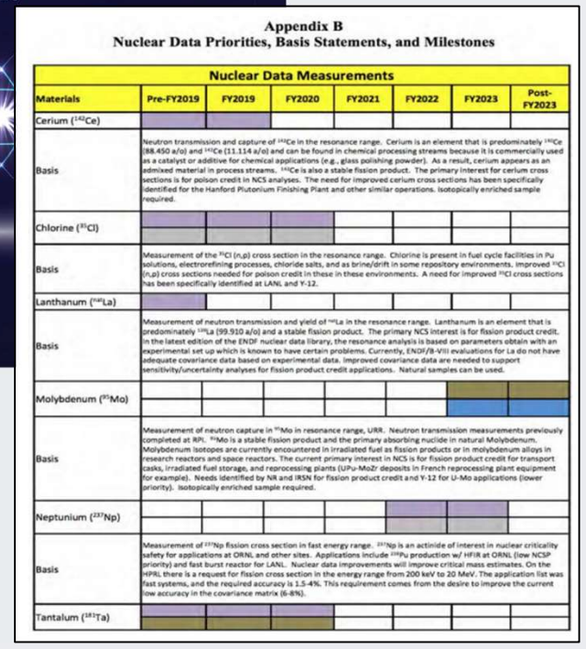
http://www.linac.rpi.edu/public_html/accelerator.html
https://neutrons.ornl.gov/sns
https://ec.europa.eu/jrc/en/research-facility/linear-electron-accelerator-facility
https://lansce.lanl.gov/

Nuclear Data Measurements & Evaluation Work for NCSP

- **Objective**: Provide measured and evaluated thermal, resonance, unresolved resonance, and fast region cross section data to address the priority NCSP nuclear data needs
- **Vision**: Addresses multiple Nuclear Data 5- and 10-year goals and attributes identified in the NCSP Vision
- **Final product**: Rigorous ENDF/B evaluations produced from cross section measurements and analyses.
- Measurement work effort focused on NCSP priorities by NCSP Nuclear Data Advisory Group (NDAG)
- NCSP 5-year plan provides a listing of Nuclear Data measurement and evaluation priorities for the program

- DOWNLOAD FY2025 5-year plan:
  - https://ncsp.llnl.gov/sites/ncsp/files/2025-01/ncsp_five-year_execution_plan_fy2025-2029-r2.pdf





Appendix B
Nuclear Data Priorities, Basis Statements, and Milestones

Nuclear Data Measurements

Materials	Pre-FY2019	FY2019	FY2020	FY2021	FY2022	FY2023	Post-FY2023
Cerium (^{142}Ce)							
Basis	Neutron transmission and capture of ^{142}Ce in the resonance range. Cerium is an element that is predominately ^{140}Ce (88.450 a/o) and ^{142}Ce (11.114 a/o) and can be found in chemical processing streams because it is commercially used as a catalyst or additive for chemical applications (e.g., glass polishing powder). As a result, cerium appears as an admixed material in process streams. ^{142}Ce is also a stable fission product. The primary interest for cerium cross sections is for poison credit in NCS analyses. The need for improved cerium cross sections has been specifically identified for the Hanford Plutonium Finishing Plant and other similar operations. Isotopically enriched sample required.						
Chlorine (^{35}Cl)							
Basis	Measurement of the ^{35}Cl (n,p) cross section in the resonance range. Chlorine is present in fuel cycle facilities in Pu solutions, electrorefining processes, chloride salts, and as brine/drift in some repository environments. Improved ^{35}Cl (n,p) cross sections needed for poison credit in these in these environments. A need for improved ^{35}Cl cross sections has been specifically identified at LANL and Y-12.						
Lanthanum (^{138}La)							
Basis	Measurement of neutron transmission and yield of ^{138}La in the resonance range. Lanthanum is an element that is predominately ^{139}La (99.910 a/o) and a stable fission product. The primary NCS interest is for fission product credit. In the latest edition of the ENDF nuclear data library, the resonance analysis is based on parameters obtain with an experimental set up which is known to have certain problems. Currently, ENDF/B-VIII evaluations for La do not have adequate covariance data based on experimental data. Improved covariance data are needed to support sensitivity/uncertainty analyses for fission product credit applications. Natural samples can be used.						
Molybdenum (^{95}Mo)							
Basis	Measurement of neutron capture in ^{95}Mo in resonance range, URR. Neutron transmission measurements previously completed at RPI. ^{95}Mo is a stable fission product and the primary absorbing nuclide in natural Molybdenum. Molybdenum isotopes are currently encountered in irradiated fuel as fission products or in molybdenum alloys in research reactors and space reactors. The current primary interest in NCS is for fission product credit for transport casks, irradiated fuel storage, and reprocessing plants (UPu-MoZr deposits in French reprocessing plant equipment for example). Needs identified by NR and IRSN for fission product credit and Y-12 for U-Mo applications (lower priority). Isotopically enriched sample required.						
Neptunium (^{237}Np)							
Basis	Measurement of ^{237}Np fission cross section in fast energy range. ^{237}Np is an actinide of interest in nuclear criticality safety for applications at ORNL and other sites. Applications include ^{239}Pu production w/ HFIR at ORNL (low NCSP priority) and fast burst reactor for LANL. Nuclear data improvements will improve critical mass estimates. On the HPRL there is a request for fission cross section in the energy range from 200 keV to 20 MeV. The application list was fast systems, and the required accuracy is 1.5-4%. This requirement comes from the desire to improve the current low accuracy in the covariance matrix (6-8%).						
Tantalum (^{181}Ta)							

FY2025 NCSP "Strategic Priorities List"

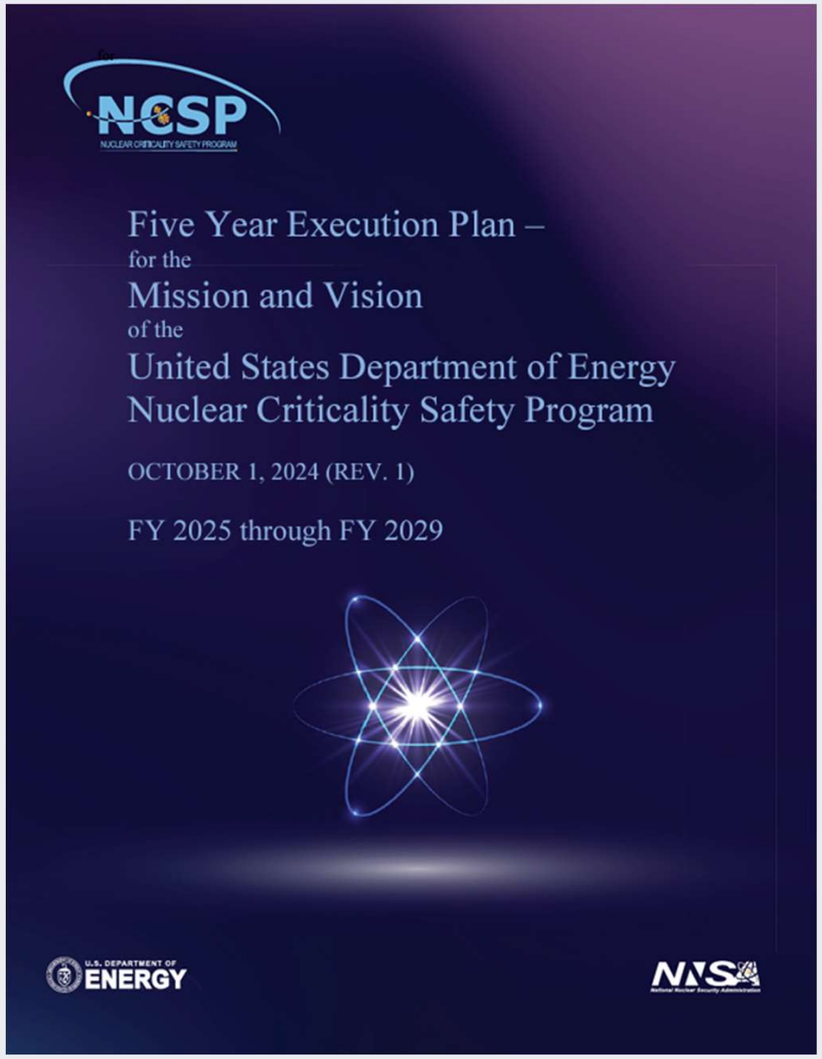


Table 2.2 NCSP "Strategic Priorities List" for FY2025

#	Milestone Description	TPE	Lead Site
1	Process ENDF/B-VIII.1 into ACE format for MCNP and release via the LANL nuclear data website	AM	LANL
2	Complete updated SlideRule plutonium calculations	AM	IRSN/ORNL/LLNL
3	Document investigated analysis methods associated with criticality monitoring for Fukushima fuel debris removal. (IE35)	IE	LANL
4	Increase Planet's rated load capacity.	IE	LANL
5	Perform NCERC critical experiment for Ta validation supporting plutonium processing operations. (IER 607)	IE	LANL
6	Complete Section 1 draft of the PFUNS ICSBEP benchmark evaluation (IER 153).	IE	LANL
7	Submit CERBERUS benchmark evaluation to the ICSBEP TRG. (IER 537)	IE	LANL
8	Submit Godiva Benchmark Evaluation to ICSBEP TRG (IER 555)	IE	LANL
9	Execute MOX Experiments at NCERC in collaboration with IRSN (IER 296)	IE	LANL/IRSN
10	Report on CAAS testing for AWE (IER 605)	IE	LANL/AWE
11	Submit TEX-Cl (IER 499) benchmark to ICSBEP TRG.	IE	LLNL
12	Complete TEX-Fe Experiments (IER 519)	IE	LANL/LLNL
13	Complete procurement of materials for Low Temperature TEX (IER 479)	IE	LANL/LLNL
14	Complete procurement of materials for SPRF/CX temperature dependent benchmark (IER 304).	IE	SNL/ORNL
15	Complete NCERC Control Room #1 upgrades*	IE	LANL
16	Submit benchmark evaluation of epithermal experiments to the ICSBEP TRG (IER 441)	IE	SNL/ORNL
17	Complete final design for TEX-Li (CED-2) (IER 575)	IE	LLNL
18	Update Pu-240 evaluation to include new LANSCE / Chi-Nu prompt fission neutron spectra	ND	LANL
19	Complete Zr-92 nuclear data measurements at GELINA	ND	ORNL
20	Complete Phase 2 of RPI LINAC refurbishment	ND	RPI/NNL
21	Complete unit acceptance tests for accelerator sections #2 and #3	ND	RPI/NNL
22	Provide a summary of LfE Database entries provided by the NCS community	IPD	ORNL/LLNL

*Funding for control room upgrades provided by NA-19's Capabilities-based Investment Program (CBI)

FY2025 NCSP "Strategic Priorities List"

14	Complete procurement of materials for SPRF/CX temperature dependent benchmark (IER 304).	IE	SNL/ORNL
15	Complete NCERC Control Room #1 upgrades*	IE	LANL
16	Submit benchmark evaluation of epithermal experiments to the ICSBEP TRG (IER 441)	IE	SNL/ORNL
17	Complete final design for TEX-Li (CED-2) (IER 575)	IE	LLNL
18	Update Pu-240 evaluation to include new LANSCE / Chi-Nu prompt fission neutron spectra	ND	LANL
19	Complete Zr-92 nuclear data measurements at GELINA	ND	ORNL
20	Complete Phase 2 of RPI LINAC refurbishment	ND	RPI/NNL
21	Complete unit acceptance tests for accelerator sections #2 and #3	ND	RPI/NNL
22	Provide a summary of LfE Database entries provided by the NCS community	IPD	ORNL/LLNL

NCSP Nuclear Data Measurements and Evaluations in Progress – FY2025 5-Year Plan

Measurements	
Materials	**Site**
Cesium (^{133}Cs)	LANL
Chlorine (^{35}Cl)	ORNL, LANL
Chromium (^{50,52,53}Cr)	ORNL
Fluorine (^{19}F)	ORNL
Plutonium (^{239}Pu)	LANL
Plutonium (^{240}Pu)	LANL, LLNL
Samarium (^{149}Sm)	LANL
Tantalum (Ta)	RPI
Uranium (^{233}U)	LANL
★ Zirconium (^{90,91,92,94,96}Zr)	ORNL
Beryllium (Be)	NNL
Mobilmet	RPI, NNL
Petrolatum	NNL

Evaluations	
Materials	**Site**
Beryllium (^{9}Be)	LANL
Carbon (^{12}C)	LANL
Chlorine (^{35,37}Cl)	ORNL, LANL
Copper (^{63,65}Cu)	ORNL, LANL
Fluorine (^{19}F)	ORNL
Gadolinium (^{155,157}Gd)	ORNL, NNL
Hafnium (^{176,177,178,179,180}Hf)	ORNL, NNL
Iron (^{54,56,57}Fe)	ORNL, BNL
Iron (^{56}Fe)	ORNL, BNL
Lanthanum (La)	ORNL, LANL
Lithium (^{6}Li)	LANL
Molybdenum (^{95}Mo)	ORNL, NNL
Nitrogen (^{14}N)	ORNL
Oxygen (^{16}O)	LANL, ORNL

Evaluations	
Materials	**Site**
Plutonium (^{238}Pu, ^{241}Pu, ^{242}Pu)	LANL
Plutonium (^{239}Pu)	LANL, ORNL
Plutonium (^{240}Pu)	ORNL, LANL
Rhodium (^{103}Rh)	ORNL, NNL
Uranium-233	LANL
Uranium-234	ORNL, LANL
Uranium-235	ORNL, LANL
Uranium-236	LANL
Uranium-238	LANL, BNL
Vanadium (^{51}V)	ORNL
Zirconium (^{90,91,92,94,96}Zr)	ORNL, RPI, NNL, BNL
Light Paraffinic Oil (Mineral Oil)	LLNL, NCSU
Triuranium Octoxide (U_3O_8)	NCSU

Ramping Up

Ramping Down

★ Strategic Priority Item

NCSP Cross-Cutting Nuclear Data Work

- NCSP Nuclear Data work items support many different programs
  - Improvements to U-235, U-238, and Pu-239 are cross-cutting for virtually all programs
  - U-233, Pu-240, Np-237 of interest to NNSA (NA-10 & NA-20), DOE-NE, NCSP international collaborators, and the NRC
  - Fe is cross cutting for virtually all programs
  - Chlorine is cross cutting for NNSA NA-10 (electrorefining, Pu aqueous chloride processing, repository applications) and DOE-NE/NRC (molten chloride salt reactors) where there a significant uncertainties associated with the (n,p) reaction. Needs for repository situations (DOE-EM/WIPP)
  - Fission products useful for programs that utilize burnup credit analysis
  - Zr & Hf of interest to NNSA NA-30 (NR)
  - Ta cross cutting with NNSA NA-10 for pit production
  - Thermal Scattering Law work is cross-cutting with NNSA (NA-10, NA-20), DOE-NE, and NRC

NCSP Benefits/Successes

- NCSP support of each major ENDF/B library release supports reduced bias in eigenvalue (k_{eff}) computations to support nuclear criticality safety limit development
  - NCSP provided significant support for the ENDF/B-VIII.1 library
- Integral experiment capabilities at NCERC and Sandia are funded by the NCSP to ensure facility availability for sponsor use (non-NCSP) and for new critical experiments to support the NCS community
- NCSP performs differential measurements at RPI, LANL (LANSCE), ORNL (Spallation Neutron Source) and GELINA (Geel, Belgium)
- NCSP funds all aspects of the nuclear data pipeline to support the NCS community
  - Supporting process operations with hands-on operations with fissionable material
- NCSP supports university proposals for our human resource pipeline – many success stories here

Questions

Photo from our 2025 Technical Program Review
Hosted by Los Alamos National Laboratory